

# Automated Synthesis of QFT Controllers and Prefilters for SISO and MIMO Magnetic Levitation system using ICST

Special Topic Seminar

By

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# Motivation

- The automatic synthesis of a SISO and MIMO QFT controllers is still an open problem.
- The most successful method for such a design takes into consideration the non-linear/non-convex QFT bounds without any approximation.
- It thereby ensures closed loop stability of the system, and becomes largely independent of the initial controller solution.
- Magnetic Levitation system is subjected to many external disturbances.
- It is highly nonlinear system.

# Outline

- 1 Introduction
- 2 Brief of Magnetic Levitation setup
- 3 Mathematical Modelling of Magnetic Levitation System
- 4 Preliminaries- QFT and Constraint Solver
- 5 QFT Controller Synthesis Problem
- 6 Proposed QFT Controller Synthesis Method and Prefilter Design for SISO case
- 7 Proposed QFT Controller Synthesis Method and Prefilter Design for MIMO case
- 8 Discussion
- 9 Conclusions and Future Work

# Introduction to Magnetic Levitation Setup

## Schematic of Magnetic Levitation Experimental Setup



# RAIT

# Sensor Linearization for Lower Magnet and Coil

Table: Raw Sensor Data for Lower SISO case

Magnet position (cm)	Raw Sensor Output $y_{1raw}$ (counts)
0	27900
0.5	22700
1	18300
2	12000
3	8200
4	5800
5	4100
6	2800

# Sensor Nonlinearity

$$y_{ical} = \frac{e_i}{y_{iraw}} + \frac{f_i}{\sqrt{y_{iraw}}} + g_i + h_i y_{iraw}$$

$$e_1 = -11347, f_1 = 713.5441, g_1 = -2.9904, h_1 = -2.5283 * 10^{-5}$$

$$e_2 = 7109.4, f_2 = -581.75, g_2 = 1.8355, h_2 = 4.1371 * 10^{-5}$$

# Thank You...